

CAF/22/20 – Quantification and Standard Uptake Values in Dual Isotope SPECT-CT Imaging.

Two-dimensional nuclear medicine images are limited by overlying organs and tissues, making interpretation difficult. One solution is to acquire 3D-SPECT (single photon emission computed tomography) images to show tissue function alongside CT images of corresponding anatomy. Recent advancements in SPECT imaging include quantification to measure the uptake and function of different tissues using standard uptake values (SUVs). With reliable quantification, we have the opportunity to improve diagnostic accuracy which will enhance disease localisation prior to surgical intervention.

In both parathyroid and infection imaging, injecting two different radioactive tracers together allows us to see the function of different tissue at the same time; dual isotope imaging is possible due to the different radiotracer energies, however, imaging is technically more challenging. Higher radiotracer energies may scatter into lower energy windows – this is called downscatter which can significantly degrade image quality. There are few publications available on the correction of downscatter and its impact on quantification accuracy.

Previous research from our centre found our 3D and subtraction imaging to be efficient in detecting parathyroid disease, however, there remains a small risk of repeat surgery due to failure in detecting multiple overactive glands within imaging. The addition of SPECT quantification can be used to identify disease types and decide the best treatment for the patient, giving the best possible clinical outcome. This project will apply novel methods of SPECT quantification to a dataset of patients for dual-tracer parathyroid and infection imaging.

The aims of this research include:

- Investigate SUV quantification feasibility for parathyroid imaging to provide more information and improve the diagnostic report accuracy.
- Determine if SUVs can classify the type and stages of parathyroid disease, including non-cancerous mass, enlarged gland, multiple gland disease or parathyroid cancer.
- Provide evidence to support streamlining of patient imaging pathways as uncertainty in the diagnostic report often leads to multiple imaging procedures using ultrasound and 4D-CT.
- Assess SUV quantification in infection imaging and introduce routine 3D SPECT and subtraction imaging.
- Establish if SUV measures can identify between infection, inflammation or healing bone.
- Develop a correction technique for downscatter and improve our measure of SUV for dual-tracer procedures.
- Assess software which is used to improve imaging of metal implants and determine its impact on SUV quantification.

The methods of this project will involve patient audits, validation of quantification and the development of correction techniques to aid in complex dual-tracer imaging. Currently, patients undergo a number of imaging procedures increasing the number of hospital visits, radiation dose and the strain on the NHS. Particularly in the diagnosis of parathyroid disease which involves nuclear medicine imaging, ultrasound and 4D-CT.

This work will streamline this patient pathway by improving our reporting of 3D-SPECT and potentially reducing the need for additional imaging with 4D-CT. For the diagnosis of parathyroid disease and infection, improving our patient pathways will reduce the number of patient attendances required, benefiting our patients and clinical service. The addition of quantification to dual-tracer imaging will improve diagnostic reporting and surgical guidance.